EXHIBIT D
SECTION 103 EVALUATION

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DISPOSAL OF COLUMBIA RIVER AND MOUTH OF THE COLUMBIA RIVER DREDGED MATERIAL AT NEW DEEP WATER SITE AND SITE E
OREGON AND WASHINGTON

TABLE OF CONTENTS

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INTRODUCTION

This evaluation addresses the use of ocean disposal Site E and the Deep Water Site for disposal of dredged material from the existing Mouth of the Columbia River entrance channel (MCR), maintenance of the existing Columbia river channel and proposed Columbia River Federal navigation channel deepening in accordance with Environmental Protection Agency (EPA) regulations (40 CFR Parts 227 and 228). This evaluation is a summation of the information contained in the rest of this EIS including all appendicies. Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA) requires that all actions involving the transportation of dredged material with the intent to dispose of the material in ocean waters be evaluated for environmental effects prior to making the disposal. The purpose of this 103 Evaluation is to (1) select new MCR ocean disposal sites, Site E and the Deep Water Site, and (2) evaluate the suitability of dredged material from channel deepening construction and maintenance and MCR maintenance for ocean disposal at the new sites.

The four presently designated ocean dredged material disposal sites (A, B, E and F) were designated by EPA in a final rule published in the *Federal Register* (FR29923-29927) on August 21,1986 and the designation became effective September 22, 1986. The designated sites were subsequently expanded under joint EPA-Corps Section 103 authority to alleviate persistent mounding at Sites A and B. Environmental Assessments, Coastal Zone Consistency Determinations and Section 103 Evaluations were prepared to address the effects of the site expansion actions. Of the four EPA sites, only expanded Site E is recommended for formal EPA designation. Sites A, B and F will be de-designated by EPA action.

Nearly all of the material placed in these sites, which has averaged about 4.5 million cubic yards (mcy) per year (1992 to 1996), has been from the MCR project. Because of the historic and predominate use of the ocean dredged material sites for placement of dredged material from the MCR project the information presented in this appendix focuses on this project. However, ocean disposal of volumes of material from the existing and proposed deeper Columbia River channel will be needed; this material would come from the Columbia River estuary downstream of river mile (RM) 30. Potential estuarine and upland site capacity is extremely limited. As estuarine disposal capacity is reduced, transportation of material to the ocean disposal sites becomes a necessary solution.

Evaluation studies in support of selection and ultimate EPA designation of new ocean disposal sites at the mouth of the Columbia River are included in Appendix H of the Columbia River Navigation Channel Improvement Study and EIS.

NEED FOR OCEAN DISPOSAL

The Columbia River Navigation Channel Improvement Study/EIS has evaluated several alternative methods for disposal of dredged material from the lower estuary including upland, shoreline, designated in-water estuarine sites, flowlane disposal and ocean disposal. All of the alternative methods are recommended except for the use of a designated estuarine site. Ocean disposal is a recommended option because of the long-term capacity limitations of the other disposal methods and because of ongoing concerns by resource agencies and others to minimize impacts to important living resources dependent on the estuary. All ocean disposal options would include disposal at the existing Section 404 designated North Jetty Site.

ALTERNATIVES

Overview

The alternatives considered in this evaluation are no action, upland/beach disposal, estuarine disposal, disposal off the continental shelf, continued use of existing sites, and designation of new ocean disposal sites. A hopper dredge must be used to dredge the entrance to the MCR because the rough seas encountered at the entrance are not suitable for safe operation of other dredge types. Hopper dredges are self-propelled, seagoing vessels and are the only type of dredge that can work effectively in rough open water. Larger hopper dredges can work in swell conditions up to about 10 feet. Hopper dredges are also very mobile and able to move quickly so they do not interfere with traffic, and can adjust to changing weather and sea conditions. Pipeline and clamshell dredges cannot operate safely and effectively in waves greater than 3 to 4 feet. They are also unable to handle strong currents such as those experienced during tidal shifts at the MCR. Both of these type dredges use spuds and/or anchors to station themselves in the work area so they are not able to quickly move for traffic or changing conditions. Dredging for the Columbia and Lower Willamette Rivers navigation channel may be conducted by hopper, clamshell, or pipeline dredges.

No Action Alternative

The no action alternative would be to refrain from selecting new ocean dredged material disposal sites for the placement of dredged material. Options would include using the existing EPA designated sites; if there are no suitable EPA designated sites, the Corps would have to select alternate sites under its MPRSA Section 103 authority, or existing and proposed navigation projects may be terminated. The EPA sites do not have capacity to meet needs without creating hazardous navigation conditions. Neither of these disposal site options meet the needs for long-term maintenance of the MCR project, possible channel deepening, and future maintenance of Columbia River navigation project. Terminating dredging would reduce the safety of the channel for large ships and have an adverse economic impact to the nation. For these reasons, the no action alternative is considered unacceptable.

Upland/Beach Disposal

Upland disposal for MCR project maintenance material is not feasible for operational, economic, and environmental reasons. The 1983 EIS evaluated the availability of upland

sites, considering the local plan, and determined that upland disposal was not a viable alternative at that time. This situation has been periodically reviewed by the Corps and EPA, including a recent review of USGS and national wetland inventory maps; the situation has not changed. There are no known suitable upland areas in the immediate vicinity of the estuary with sufficient capacity to meet long-term disposal needs. Most of the adjacent areas are wetlands, too steep, or already developed including State Parks. The local estuary plan does not identify any suitable upland dredged material placement areas. It is estimated that an upland site would need to be 5 square miles and have material placed over 40 feet high to accommodate over 200 mcy of material.

Placement of dredged material directly on ocean beaches has been proposed in the past. Proposed placement areas have included Clatsop Spit in Oregon and Benson Beach in Washington. Interest has been expressed by the State of Washington and others for the direct placement of dredged material on Benson Beach to the north of the north jetty during this site evaluation process. However, no formal request or willingness has been expressed by a local sponsor to initiate a direct beach placement study and to assume local sponsorship responsibilities. A detailed discussion on direct beach placement of dredged material can be found in Appendix A. Because of the need to dredge the MCR with a hopper dredge, the lack of sufficient upland disposal sites, and no identified local sponsorship, upland disposal is not considered a viable alternative to ocean disposal.

Estuarine Disposal

The Corps has proposed use of an estuarine site located along the north jetty, Public Notice NWP-CO-CRA-FY98-005. The entrance channel is migrating north and there is concern that continued movement north will impact the structural integrity of the north jetty by undermining it. The static site capacity of this site is one mcy; however, it is certain to be much less than the volume required from the federal navigation projects. Additional capacity could become available if material moves from this site. It is also possible that the material could move back into the entrance channel. Hydrographic surveys will be conducted to determine the site capacity for future use.

Estuarine disposal of Columbia River channel material occurs at existing in-water and dredged material islands. Existing islands created with dredged material have limited capacity and no new or expanded sites with sufficient capacity are likely to be sited in this area due to concerns and uncertainty of potential affects to various species listed under the Endangered Species Act. Efforts to site new disposal islands or expand existing islands within the estuary have met strong resistance from regulatory and resource agencies in the past.

Ocean Disposal

Off the Continental Shelf

Potential disposal areas located off the continental shelf would be at least 20 nautical miles offshore in water depths of 600 feet or greater, with the exception of the Astoria Canyon, which is 11 nautical miles offshore.
Transporting dredged material off the continental shelf also presents environmental concerns. Benthic and pelagic ecosystems near the shelf contain important fishery resources and the effects of disposal operations on them are not well understood. Fine-grained sediment and rocky habitats would be directly impacted in disposal operations. These deep-water areas are stable and generally not disturbed by wave action or sediment movement. Consequently, these areas have benthic invertebrate communities that are adapted to very stable conditions and would be less likely to survive disturbance from disposal operations. Little is known of the ecology of benthic communities on the continental slope, and disposal in this area could cause impacts of unknown severity and duration. Bottom gradients can be 5 to 25 percent on the continental slope, making accumulated unconsolidated sediments susceptible to slumping. Deposited sediments could be transported long distances downslope as turbidity currents and offshore by near-bottom currents.

The time period for hopper dredges to safely work at entrance channels along the West Coast is generally limited to May through mid-October. However, at MCR much of the shoaling occurs during the summer after river flows drop off and therefore, most of the dredging occurs between July 1 and mid-October. During this time period the two available dredges capable of effectively working at MCR typically must work there 50 to 60 days each. The travel time to and from disposal sites is an important factor in determining hopper dredge production rates. In the future, overall travel times must be kept at or near recent levels to allow annual maintenance at MCR, the river channel, and other West Coast projects.

The cost for site evaluation/monitoring along with unanswered environmental concerns about disposal in such areas makes disposal off the continental shelf undesirable. Further, off-shelf disposal would remove natural sediments from the nearshore littoral transport system, which functions with largely non-renewable quantities of sand in Oregon and Washington. Large-scale disruption in the mass balance of this system could alter erosion/accretion patterns.

Continued Use of Existing Sites

The small size of the EPA-designated sites, and the large quantity of material requiring ocean disposal have resulted in mounding of material and potential navigation hazards. This situation would persist with continued use of the existing sites. Mounding has affected the wave climate at EPA-designated sites A and B. This has begun to adversely affect navigation safety at the MCR entrance for smaller boats. Continued use of these sites would definitely result in the further development of the existing mounds and worsen a potentially hazardous condition to navigation to go unchecked. Dredged material is already exceeding site

boundaries at the sites. Ignoring this developing condition is not a prudent or responsible management option.

New Ocean Disposal Site(s)

Based upon the discussions for the above alternatives, both the Corps and EPA concluded that the designation of new ocean disposal site(s) was necessary to meet the long-term disposal needs of the MCR project and the Columbia River channel project.

The Corps and EPA initiated the ocean dumping site designation process as part of the Columbia River channel improvement study. That process is summarized in the following section.

OCEAN DUMPING SITE DESIGNATION PROCESS

The dumping of "material" (including dredged sediments) into the ocean is permitted only at sites or in areas selected to minimize the interference of disposal activities with other activities in the marine environment. Formal designation of ocean dumping sites is the responsibility of EPA by EPA promulgation in part 228 of the ocean dumping regulations. The process followed by the EPA, Region 10, and Portland District, Corps for the Columbia River projects generally follows the site designation procedures developed by a joint task force of EPA and Corps personnel and titled, *General Approach to Designation Studies for Ocean Dredged Material Disposal Sites* (May 1984). The procedures utilize a hierarchical framework that initially establishes the broadest economically and operationally feasible area of consideration for site location. A step-by-step sequence of activities is then conducted to eliminate critical and/or unsuitable subareas. Further evaluation of alternative sites (candidate sites) within this area entails various levels of assessment as suggested by the sensitivity and value of critical resources or uses at risk, and potential for unreasonable adverse impact presented by the dredged material to be disposed. The site-designation criteria at sections 228.5 and 228.6 are applied to the information assembled through this process, and a final site or sites are selected and proposed for formal designation.

The site-designation process is structured into three major phases. Phase I includes the delineation of the general area being considered for locating a site and the identification and collection of the necessary information on critical resources and uses and on the physical and environmental processes for the area. Reasonable distance of haul is the determining factor and will be affected by considerations such as available dredging equipment, energy use constraints, costs, and safety considerations. Then a preliminary analysis, based on available data, is applied to identify and map boundaries for critical resources as well as areas of incompatibility. Such critical areas and resources may include clustered areas of geographically limited habitats, fisheries and shell fisheries, navigation lanes, beaches, and marine sanctuaries.

Phase II primarily involves the elimination of sensitive and incompatible areas, determining additional data needs, and identification of candidate sites within the area based on the

information collected and processed in Phase I. Phase III primarily involves the evaluation of candidate sites, selection of a proposed site or sites for designation, and the development of management strategies.

Because of the comprehensive and controversial conditions inherent at MCR, an Ocean Disposal Working Group composed of local, state and federal agencies and fishing industry representatives was formed to participate in all three phases of the site selection/designation process. The results of the working group efforts are discussed in detail in Appendix H. The proposed North and South sites presented in the draft feasibility study/EIS were developed during the initial phases of this process.

A large number of comments from the public review of the draft EIS in opposition to these nearshore sites were received from agencies and the fishing industry. The primary basis for opposition to these sites is potential impacts to the local crab fishery. The Corps and EPA convened additional working group meetings to discuss further refinements to the proposed ocean disposal sites.

The Corps and EPA fully support the concept of nearshore placement of material. The Corps and EPA view dredged material as a valuable resource and feel that keeping the material in the littoral zone is beneficial. Further, disposal of material in the nearshore in the active energy zone would be less biologically impacting than disposal in deep water (depths greater than 200 feet). However, the MPRSA and implementing regulations provide that consideration will be given to the effect of disposal on commercial fisheries. Many of the working group representatives felt that the spatial extent of the ocean disposal sites was still too large and impacts to the crab fishing industry may be unacceptable. As a result, the Corps and EPA agreed to reconsider any proposed use of the North and South sites.

These issues were reviewed during the final two working group meetings and, following refinement and resolution of conflict areas, the Corps and EPA selected two proposed ocean disposal sites, Site E and the Deep Water Site. This 103 Evaluation addresses the use of these proposed sites through application of the 5 General and 11 Specific criteria as required by the MPRSA.

PROPOSED ACTION

The proposed action is the use of new ocean disposal Site E and the Deep Water Site for disposal of approximately 7 million cubic yards (mcy) of sediment from initial construction of the proposed Columbia River channel deepening, and the subsequent annual disposal of approximately 5 mcy of maintenance dredged material. The material would be dredged from the Columbia River Federal navigation channel from river miles 10 to 27 (1 mcy annually) and from the MCR entrance channel (4.5 mcy annually).

LOCATION OF THE DISPOSAL SITES

The proposed ocean disposal sites are located offshore of the entrance to the Columbia River. The new Deep Water Site is located approximately 4.5 nautical miles west of the entrance channel at an average depth of about 220 feet, and Site E is located to the north of the entrance at an average depth of about 60 feet. See figure 1 for the location and configuration of the sites. Site coordinates (degrees, minutes, seconds; NAD, 1983) and dimensions of the two sites are as follows:

Proposed Site E
Corner Coordinates:

46° 15' 35" N, 124° 05' 15" W
46° 14' 31" N, 124° 07' 03" W
46° 14' 58" N, 124° 07' 37" W
46° 15' 42" N, 124° 05' 26" W

Dimensions: 1,054 x 3,600 feet wide x 10,000 feet long
Azimuth (long axis): 229° T
Depth: 45-75 feet

Proposed Deep Water Site
Corner Coordinates:

46° 11' 03" N, 124° 10' 01" W
46° 13' 10" N, 124° 12' 40" W
46° 10' 41" N, 124° 16' 47" W
46° 08' 34" N, 124° 14' 08" W

Dimensions: 17,000 x 23,000 feet
Buffer: 3,000 feet
Depth: 190-300 feet

DISPOSAL PLAN

Estimated disposal quantities are 4.5 mcy annually for maintenance of MCR entrance channel, 7 mcy for Columbia River channel deepening to be disposed over a two year time period, and approximately 1 mcy annually for maintenance of the Columbia River channel. Actual disposal quantities and locations will be determined on a year to year basis and will be coordinated with a task force consisting of agencies and users such as commercial fishing interests prior to the dredging season. Each season's disposal will be analyzed to prepare for the next dredging season.

Disposal would be distributed throughout site E and would be monitored for mounding effects and sediment dispersion. If monitoring indicates mounding, consultation with EPA Region 10 and other affected agencies and groups potentially affected by the wave climate will be initiated to determine appropriate management actions. Material placed at the Deep Water Site would be confined to the smallest area possible, intentionally mounding to minimize the area impacted each year. A Management and Monitoring Plan developed for these sites and detailing the disposal plan is included in Appendix H.

EVALUATION OF DISPOSAL SITES

EPA regulations require the evaluation of ocean disposal sites based on the 11 specific criteria and 5 general criteria contained at 40 CFR 228.5 and 228.6. Tables 1 and 2 list these criteria required for evaluation. The new sites have been evaluated under these criteria and, based on these criteria, the Corps and EPA will determine their acceptability for ocean disposal.

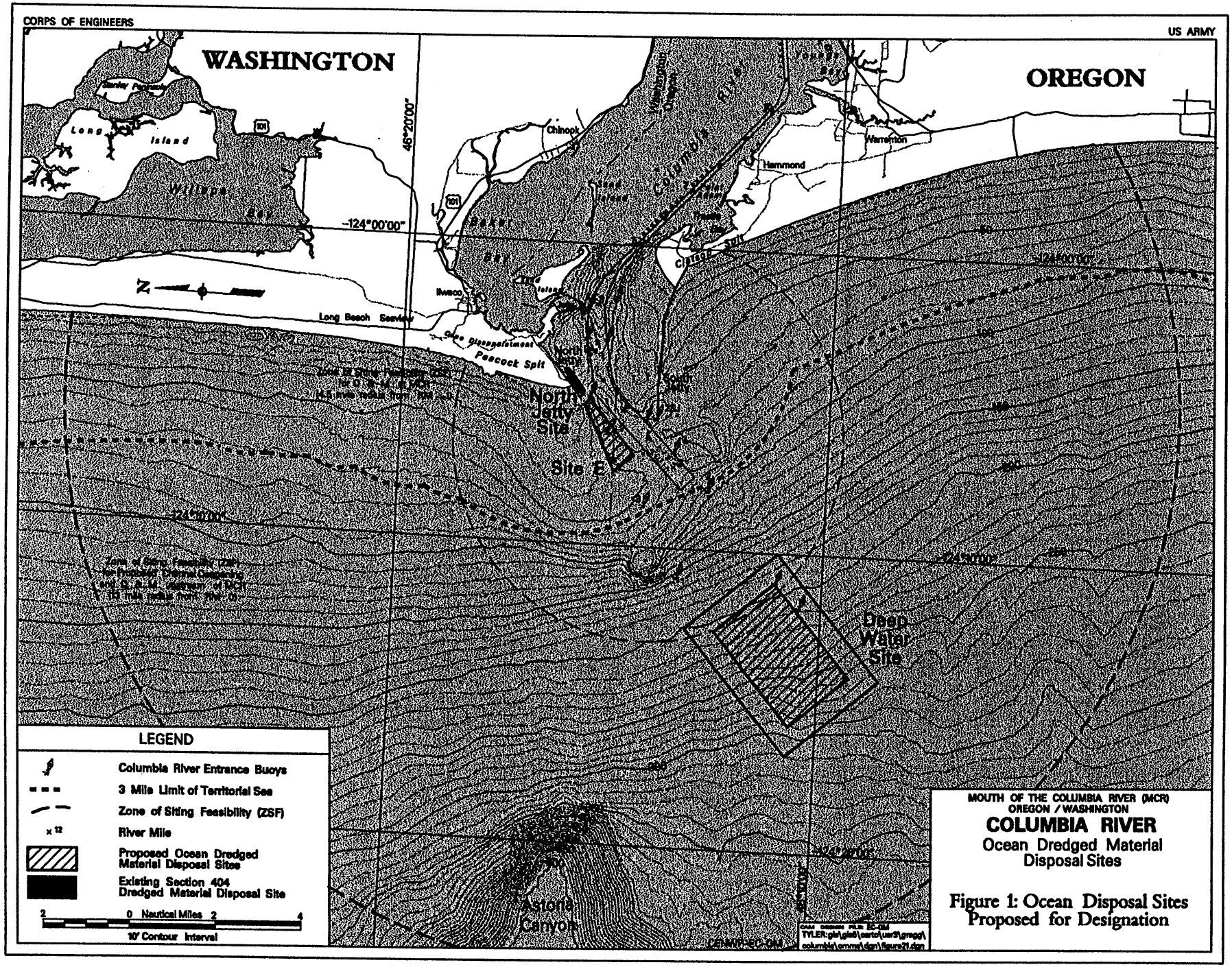

Figure 1: Ocean Disposal Sites Proposed for Designation

Table 1. Eleven Specific Factors for Ocean Disposal Site Selection

1. Geographical position, depth of water, bottom topography, and distance from coast.

2. Location in relation to breeding, spawning, nursery, feeding or passage areas of living resources in adult or juvenile phases.

3. Location in relation to beaches or other amenity areas.

4. Types and quantities of waste proposed to be disposed and proposed methods of release, including methods of packaging the waste, if any.

5. Feasibility of surveillance and monitoring.

6. Dispersal, horizontal transport, and vertical mixing characteristics of the area, including prevailing current velocity, if any.

7. Existence and effects of present or previous discharges and dumping in the area (including cumulative effects).

8. Interference with shipping, fishing, recreation, mineral extraction, desalination, shellfish culture, areas of special scientific importance and other legitimate uses of the ocean.

9. Existing water quality and ecology of the site, as determined by available data or by trend assessment or baseline surveys.

10. Potential for the development or recruitment of nuisance species within the disposal site.

11. Existence at or in close proximity to the site of any significant natural or cultural features of historical importance.

Table 2. General Criteria for the Selection of Ocean Disposal Sites

a. The dumping of material into the ocean will be permitted only at sites or in areas selected to minimize the interference of disposal activities with other activities in the marine environment, particularly avoiding areas of existing fisheries or shell fisheries, and regions of heavy commercial or recreational navigation.

b. Locations and boundaries of disposal sites will be chosen so that temporary perturbations in water quality or other environmental conditions during initial mixing caused by disposal operations anywhere within the site can be expected to be reduced to normal ambient seawater levels or to undetectable contaminant concentrations or effects before reaching any beach, shoreline, marine sanctuary, or known geographically limited fishery or shell fishery.

c. If at any time during or after disposal site evaluation studies, it is determined that existing disposal sites presently approved on an interim basis for ocean dumping do not meet criteria for site selection set forth in Sections 228.5 - 228.6, the use of such sites will be terminated as soon as suitable alternative disposal sites can be designated.

d. The sizes of ocean disposal sites will be limited in order to localize, for identification and control, any immediate adverse impacts and to permit the implementation of effective monitoring and surveillance programs to prevent adverse, long-range impacts. The size, configuration, and location of any disposal site will be determined as a part of the disposal site evaluation or designation study.

e. EPA will, wherever feasible, designate ocean dumping sites beyond the edge of the continental shelf and other such sites that have been historically used.

Application of Eleven Specific Criteria (40 CFR 228.6).

Geographic Location (1). Figure 1 shows the location of the sites proposed for use, Site E and the Deep Water Site. These sites are proposed to receive dredged material from the Corps' Columbia River and MCR navigation channels.

The proposed use of Site E would expand the existing EPA Section 102 designated Site E to included the Corps' previously selected Section 103 selected "expanded Site E". The site is located off the end of the North Jetty and would be about two miles long and expand from 1,000 feet to over 3,000 feet wide, encompassing an area of 580 acres. Water depths in the site range from 40 to 70 feet. The site has a static capacity (maximum volume within the site boundaries) of 2.1 mcy and a dynamic (dispersive) capacity (volume that could be transported away from the site by waves and currents) of 2.3 mcy per year. Most of the sand that would be transported away from Site E is expected to move north toward Peacock Spit.

The Deep Water Site is located beginning about 4.5 miles west of the entrance and extends out to about 7 miles. The site has a total disposal area of 4,300 acres and a static disposal capacity of 225 mcy. Water depths vary from 190 to 300 feet. Material placed in this site is not expected to disperse.

Distance from Important Living Resources (2). Aquatic resources of the oceanic region off the mouth of the Columbia River are described in detail in Appendix H. The proposed sites are located in areas where a wide variety of pelagic organisms occur in the water column. These include zooplankton (copepods, euphausiids, pteropods, and chaetognaths) and meroplankton (fish, crab and other invertebrate larvae). These organisms generally display seasonal changes in abundance. Since they are present over most of the coast, those from the MCR are not critical to the overall coastal population. Based on evidence from previous zooplankton and larval fish studies, it appears that there will be no impacts to organisms in the water column (Sullivan and Hancock, 1978).

Proposed Site E is located in an area that has generally had lower densities and numbers of species of benthic infauna. Areas offshore beyond the 200-foot depth contour, including the area encompassing the Deep Water Site, have consistently had higher densities and number of benthic species. Benthic infaunal samples were collected at the locations shown in Exhibit A.

The proposed sites are located in the area off the mouth of the Columbia River which supports a variety of pelagic and demersal fish species as well as shellfish including Dungeness crab. Many of these species have a reproductive strategy of releasing a large quantity of eggs so that they can survive a substantial mortality during the larval and juvenile stage. Crabs in particular release large number of eggs into the water column. The larvae that hatch from the eggs are planktonic for several months before settling to the bottom of the estuary and nearshore ocean as young crab. During this time they are subjected to a variety of environmental factors that affect their survival and have a direct affect on population numbers of adults.

Pelagic species include anadromous salmon, steelhead, cutthroat trout, striped bass, lamprey, smelt, herring, sturgeon, and shad that migrate through the estuary to upriver spawning areas. Juveniles of these species are present in the area following their migration out of the river or estuary into the ocean. Some remain in the nearshore area for various periods of time feeding and rearing, while others move directly offshore. Concerns about disposal on both soft and hard shell crab and juvenile flat fish were evaluated in a series of laboratory tests. Results of these tests indicated that both soft and hard shell crabs could survive disposal events up to ten inches if they moved into the water column during disposal, rather than staying buried in the bottom. Most crabs and all the juvenile flatfish tested moved into the water column during disposal. Other pelagic species include the Pacific herring, anchovy, surf smelt, and sea perch. Surf smelt are in nearshore areas and in the estuary in large numbers during the summer. Demersal species present in the area include juvenile flatfish which rear in the area. Resident species occur in the area throughout the year with many using the estuary as a rearing and nursery area. Species present include various species of flatfish, rockfish and other demersal species.

Potentially 30 cetacean species can occur along the coast although their numbers are generally limited. Most cetacean species occur inslope (600- to 6,000-foot depths) or offshore waters (greater than 6,000 feet deep). Harbor porpoises and gray whales were prevalent in shelf waters less than 600 feet deep. The larger cetaceans (whales) typically occur as migrants in the spring and fall, such as the California gray whale. Smaller cetaceans, principally dolphins, porpoises, and some small whales are also present. Five species of pinnipeds are known to occur along the coast: northern sea lion, California sea lion, harbor seal, northern elephant seal and northern fur seal. Harbor seals are resident whereas the four other species of pinnipeds are more transient in nature. Harbor seals and California/northern sea lions are the principal species observed in the estuary. All three species are known to forage within the estuary and adjacent ocean waters.

Four species of marine turtles (loggerhead, green, Pacific ridley, and Pacific leatherback) have been recorded from strandings along the coastline since 1982. Marine turtles are unusual in their occurrence along the Pacific Coast and are typically associated with warmer marine waters.

Pelagic birds are extremely numerous in the offshore area. Studies have found that seabird populations were most densely concentrated over the continental shelf (less than 600 feet in depth). Shearwaters, storm petrels, gulls, common murres and Cassin's auklets numerically dominated the pelagic bird fauna from late spring through late summer. Phalaropes, fulmars and California gulls are important constituents of the fall pelagic bird flocks. The principal species in the winter are phalaropes, California gulls, fulmars, other gulls, murres, auklets, and kittiwakes. Red-throated, Pacific and common loons occur as spring and fall migrants. Western, red-necked, horned, and eared grebes also occur in the area. Brown pelicans occur from late spring to mid-fall along the coast. This species forages in nearshore waters of the Pacific Ocean and estuarine waters of the Columbia River. Concentrations up to 1,000 birds have been reported. Three species of cormorants and three species of terns occur and forage in nearshore Pacific Ocean waters and the estuary.

The federally listed threatened and endangered species which may occur within the area of the proposed sites include: listed salmon and steelhead stocks; blue, finback, sei, right, hump-backed and sperm whales; loggerhead, green, Pacific ridley, and Pacific leatherback sea turtles; northern (Steller) sea lion; marbled murrelet; bald eagle; Aleutian Canada goose; peregrine falcon; and brown pelicans. These species vary in season and location of occurrence in the offshore area.

Distance from Beaches and other Amenities (3). Site E is located within the river mouth and about one mile from local beaches. The shoreward edge of the Deep Water Site is approximately 4.5 nautical miles off the beach in 200 feet of water. Dredged material placed at Site E would likely be transported inshore by summer wave conditions. Material placed in the Deep Water Site is unlikely to move or directly impact beaches.

Types and Quantity of Disposal Material (4). The proposed sites will receive dredged materials transported by either government or private contractor hopper dredges or dump barges in accordance with the Site Management and Monitoring Plan prepared for this action. Current hopper dredges or dump barges available for use have hopper capacities ranging from 800 to 6,000 cubic yards. This would be the likely volume range of dredged material deposited in any one dredging placement cycle. The approximately 4.5 mcy estimated to be removed annually from the MCR, and .6 mcy of Columbia River channel maintenance can be placed at the sites in one dredging season by any combination of private and government dredges. In addition, 7 mcy from the Columbia River Channel construction would be placed in two seasons if approved. The dredges or barges would be under power and moving during disposal, allowing the maintenance of steerage. The sites have been sized to accommodate the projected quantities to be placed.

Materials dredged for offshore disposal traditionally came from shoals in the MCR entrance channel. They consist primarily of marine sand transported into the entrance by wave and tidal action. The material is clean, containing no contaminants of concern in excess levels, is far removed from known sources of contaminants, and is acceptable for unconfined open-water disposal. Material proposed to be dredged from the Columbia River navigation channel (RM 6 to 29) for operation and maintenance purposes and possible channel deepening have been or would be evaluated and found acceptable for unconfined open-water disposal. These sediments consist of sands with low percent of silts and clays or organic material. Some fine-grained material from side channels or backwater areas may be placed offshore in the future which will require testing and evaluation in accordance with the Dredged Material Evaluation Framework established for the Columbia River.

Feasibility of Surveillance and Monitoring (5). Monitoring shall be in accordance with the Site Management and Monitoring Plan prepared for this action. At a minimum, annual bathymetric surveys will be conducted in areas that receive dredged material, more frequent surveys will be conducted when necessary to ensure unacceptable mounding is not occurring in Site E or in the near vicinity that could pose a threat to navigation safety. Off-site monitoring will be necessary at Site E, at least during the initial few years of use. Mounding at the Deep Water Site would be kept at the minimum necessary to avoid unacceptable wave

climate. Routine monitoring for management purposes at this site would likely focus on determining how to concentrate dumps into the site and verification that material is not placed in the buffer zone. No off-site monitoring is contemplated for the Deep water Site.

If actual field monitoring of the disposal activities is required because of a future concern for habitat changes or limited resources, several research groups are available in the area to perform any required work. All of the sites are readily accessible. Most monitoring work for any of the nearshore sites could be performed from small surface research vessels at a reasonable cost. Monitoring at the Deep Water Site may be more problematic and require a more costly medium to large size vessel.

Dispersal, Horizontal Transport, and Vertical Mixing Characteristics of the Area (6). The Columbia River estuary is a sink for marine sediments, which enter through the Mouth of the Columbia River. The estuary also effectively traps most or all of the coarser fluvial sediments. Finer fluvial sediments held in suspension are passed through the estuary into the ocean.

Sediment movement in the littoral zone consists of two mechanisms depending upon sediment grain size. Sediments finer than sand (passes the 230 sieve) remain in suspension in the water and are relatively quickly removed offshore. The almost total lack of silts and clays within the Mouth of the Columbia River and Columbia River navigation channel attests to the efficiency of this mechanism. Sediments, sand size or coarser, may be occasionally suspended by wave action near the bottom, and are moved by bottom currents or directly as bedload. Tidal, wind and wave forces contribute to generating bottom currents that act in relation to the sediment grain size and water depth to produce sediment transport. Net transport for sand sized material along the Oregon and Washington coast is to the north-northwest at a very slow rate (Sollitt, 1983; Corps, 1978). Sand placed in depths less than 70 feet is expected to be mobilized by these forces and transported within the littoral system.

Sediment placed in Site E is expected to remain in the littoral system. Most of the material is expected to move northerly across Peacock Spit while some may move to the east or south. Sediments placed in the Deep Water Site are expected to be removed from the littoral system and remain offshore.

Effects of Previous Disposal (7). Between 1905 and 1940, approximately 8 mcy of sediment had been dredged from the MCR entrance bar and placed in open water by hopper dredge. Between 1945 and 1955, a total of approximately 13 mcy was dredged, while between 1956 and 1998, a total of 184 mcy has been dredged and placed in-water. The total volume of material dredged from the MCR channel between 1904 and 1998 is approximately 206 mcy. Limiting placement to the EPA-designated sites began in 1977. The most pronounced feature or result of past disposal has been the development of mounds at EPA-designated sites A and B. Mounding has altered the bathymetry to the point that the wave climate in the area has been affected. Monitoring of benthic infauna has shown no negative long-term effects due to dredged material disposal even where mounding has occurred. Oceanographic conditions are the driving factor in benefic infaunal productivity and diversity. The exception is lowered

productivity on the crest of the mound created in EPA-designated site B. Crab fishermen have also reported lower crab yields in the area of the mound at site B, which may be due to reduced productivity or the more difficult conditions for setting and retrieving crab pots.

The 1986 EPA designated Site E has received varying quantities of dredged material since that year. The Section 103 expansion of Site E was first used for disposal in 1998. Hydrographic surveys showed some initial accumulation of sediment, with erosion evident by the September 26, 1998 survey. Most of the material moved out of the site by the spring of 1999, but some material remained in the west end. The Deep Water Site has not been used for disposal in the past. Detailed analysis of previous site use is included in Appendix H.

Interference with Other Uses of the Ocean (8).

a. Commercial and Recreational Fishing. Major commercial and recreational fishing areas occur in the offshore area. The predominant commercial fisheries are for salmon, Dungeness crab, bottom fish and pink shrimp. Salmon trolling and crab fishing are done over much of the nearshore area. The actual location and effort, however, varies from year to year depending upon the abundance of fish or crabs, and resulting seasonal restrictions. The principal recreational fishing occurring off the MCR is for salmon and bottom fish. Salmon fishing is done by charter boat and private boat and occurs in the same areas as the commercial fishing but generally closer to shore. Bottom fishing is conducted by private and charter boat for halibut, rockfish, and lingcod which are generally associated with rocky areas Disposal of sandy dredged material on rocky substrate would significantly alter the habitat favored by some bottom fish. Other recreational activities include clamming in the bay and along the beach and fishing off the jetties. Except for crabbing, dredging operations have not been identified as impacting any of these fishing activities.

Crab fishermen have stated that disposal of material at the existing ocean dredged material disposal sites have already affected their fishery by creating mounds which effects small boat navigation, or create a soft bottom condition which lets crab pots sink into the sediments making removal difficult, expensive or impossible. Crab pots have been damaged or lost due to burial when dredged material was placed or by the dredges snagging the buoy lines. The Corps has been and will continue to coordinate with the fishermen to minimize this impact. They have also expressed concern that disposal kills crabs by smothering them or by changing the bottom habitat which may reduce the number of crabs available to catch.

Dungeness crabs are distributed widely throughout the area and fishing occurs in most areas north and south of the Columbia River and out into deep ocean water (300+ feet). Throughout the site selection process, the crab fishermen identified specific areas that produced more income for their crab fishing effort. These areas were identified only by the small number of mostly Washington fisherman that responded to a survey conducted by Portland District. Additional information from some Oregon fishermen was provided by ODFW following DEIS review. Consequently, these areas may not accurately represent the cross-section of all fishermen operating out of the Columbia River. Nevertheless, these areas

were avoided to the extent possible in the Corps and EPA configuration of the proposed sites.

In order to evaluate the impacts to individual crabs by dredged material disposal, the Portland District contracted with Battelle Northwest Laboratories in Sequim, Washington, and Scripps Institution of Oceanography in La Jolla, California, to conduct tests on crabs. Because assessing these impacts during an actual disposal event could not be done in the ocean it was decided to simulate disposal conditions in the laboratory. The tests at the Battelle Lab were done with recently molted soft shelled crabs, which have the greatest potential for mechanical damage during a disposal event. The tests at the Scripps Lab were done using hard shell crab, since soft shell crabs were not available.

The thickness and duration of individual disposal events tested were calculated from a model that simulated disposal events at the following water depth 50, 100, 150 and 200 feet. This provided a range of likely water depths of proposed disposal. The model predicts that the dredged material will be deposited on the bottom with the maximum thickness at the peak of the mound. It was decided to use this maximum thickness because it would represent worst case conditions. This thickness, however, would only occur in about 10 percent or less of the disposal mound with the rest progressively thinner. The duration used in the tests was a mid-point of the total duration given by the model for the entire disposal event starting from initial contact of the material with the bottom to the final collapse of the disposal mound. The mid-point was estimated to be the time when the maximum thickness of sediment was reached.

Results of the Battelle and Scripps tests are shown in tables 3 and 4. The number of crabs tested was fairly small particularly for the larger adult crabs. Test results show a large range of survival that was generally less at deeper depths of sediment than at shallower ones. There appeared to be a reduction in survival with increasing size of crabs and increasing thickness of sediment. Although this may indicate that larger crabs do not survive as well, it is probably more an indication that the 21-inch diameter test tank was too small to allow the larger crabs to escape with lateral movement as they would naturally. This would be consistent with the Scripps tests that showed a much higher survival of larger crabs at the same thickness of sediment by using a larger test tank (the test tank was 2 feet wide by 12 feet long).

These survival figures are based on worst case conditions since the thickness of sediment tested was the maximum thickness of the mound. In actuality the thickest part of the mound is only a small percentage of the area impacted by disposal. In the case of disposal in 50 feet of water, the scenario that would produce the thickest sediment in the shortest period of time, only 10 percent of the mound is thicker than 4.2 inches and approximately 20 percent was thicker than 2.2 inches. Using a constant thickness of sediment in the tests produces an overestimate of the actual mortality to the crabs during a real disposal event that produces a mound. Consequently, in order to get the actual mortality of to the crabs impacted by the disposal event the mortalities should be adjusted to account for the mortalities associated with the different thickness of material in the mound. Summing the mortalities from each of the different thicknesses of the mound gives a more accurate estimate of overall mortality. The data presented in table 5 shows this estimated mortality. As is indicated mortality is considerably less than using the conservative estimate.

Table 3. Battelle Disposal Tests on Soft Shelled Crabs

Size Group of Crabs (mm)	Thickness of Sediment (inches)	Number Tested	Number Immediately Visible After Test	Total Number After 24 Hrs	Total Number After 48 Hrs	Survival Ratio	Percent Survival
<50	2.4	5	3	3	4	4/5	80
	4.2	14	11	11	11	11/14	79
	6.6	10	9	9	9	9/10	90
	10.2	11	10	10	10	10/11	91
50-100	2.4	6	6	6	6	6/6	100
	4.2	10	6	6	6	6/10	60
	6.6	6	3	3	3	3/6	50
	10.2	11	5	5	5	5/11	45
>100	2.4	1	1	1	1	1/1	100
	4.2	4	4	4	4	4/4	100
	6.6	5	1	1	1	1/5	20
	10.2	3	1	1	1	1/3	33

Table 4. Scripps Tests on Disposal Impacts on Hard Shelled Crabs

Size Group of Crabs (mm)	Thickness of Sediment (inches)	Number Tested	Number Immediately Visible After Test	Total Number After 24 Hrs	Total Number After 48 Hrs	Survival Ratio	Percent Survival
114-159mm	Wet 10.2	13	8	9	11	11/13	85
121-168mm	Dry 10.2	12	8	11	11	11/12	92
121-165mm	Wet 10.2	12	12	12	12	12/12	100

Table 5. Survival of Dungeness Crabs Based on Percent of Disposal Mound by Thickness

Disposal in 50 Feet of Water

Sediment Thickness in Inches	Percent of Disposal Mound	Mortality >50mm crabs	Weighted Mortality >50mm	Mortality 50-100mm crabs	Weighted Mortality 50-100 mm	Mortality <100mm crabs	Weighted Mortality <100 mm
6.0-10.2	8	10	0.8	55	4.4	74	5.9
3.6-6.0	10	16	1.6	40	4.0	0	0
<2.2	82	20	16.4	0	0	0	0
Weighted Average Mortality			18.8		8.4		5.9

Disposal in 100 Feet of Water

Sediment Thickness in Inches	Percent of Disposal Mound	Mortality >50mm crabs	Weighted Mortality >50mm	Mortality 50-100mm crabs	Weighted Mortality 50-100 mm	Mortality <100mm crabs	Weighted Mortality <100 mm
6.0-10.2	1	10	0.1	55	0.5	74	0.7
3.6-6.0	6	16	1.0	40	2.4	0	0
<2.2	93	20	18.6	0	0	0	0
Weighted Average Mortality			19.7		2.9		0.7

Disposal in 200 Feet of Water

Sediment Thickness in Inches	Percent of Disposal Mound	Mortality >50mm crabs	Weighted Mortality >50mm	Mortality 50-100mm crabs	Weighted Mortality 50-100 mm	Mortality <100mm crabs	Weighted Mortality <100 mm
6.0-10.2	0	10		55		74	0
3.6-6.0	0	16		40		0	0
<2.2	100	20	20.0	0	0	0	0
Weighted Average Mortality			20.0		0		0

An observation made during all of the disposal tests was that individual crabs behaved differently, thus having a direct effect on their survival. In all the tests conducted crabs were allowed to bury into the sediment before the test dump was done. During the dump crabs either moved up into the water column or remained buried. Those that remained buried mostly did not dig out and subsequently did not survive the test. The mortality however was due not to mechanical damage during disposal but their apparent inability to dig out of the sand mass after disposal and subsequent suffocation. Crabs that recovered from the sand mass within a short period of time were alive and did not appear to have any injuries. In fact, most were kept in the holding tanks and re-tested at a later date. All crabs tested and recovered were held for an extended period of time with no indication that delayed mortality had occurred. This behavior was observed for both soft and hard shelled crabs so it was not a result of the weakened condition of the soft shelled crabs.

The reason why these crabs did not dig themselves out after disposal was not apparent; however, it may be that crabs are being buried and unburied by wave and current action naturally. Oceanographic instruments placed at the MCR have shown that up to 6 inches of sediment fluctuation can occur naturally within two hours. Further, using a constant thickness of material in a static environment would not be representative of an actual disposal event. Consequently some crabs may not be responding as they would naturally.

Results of the limited testing seems inconclusive. In all the tests done, no crabs appeared to be killed or injured by mechanical damage (all crabs removed from the sand mass were healthy). The only mortality occurred when they did not dig out of the sand mass. Whether or not this behavior is typical of what occurs in nature is unknown. It seems unlikely, however, that organisms that live in a environment where they are constantly being buried under sand, such as at the MCR, would have evolved a behavior that would result in their mortality. It seems more likely that the mortality associated with this behavior is an artifact of the testing and that the tests do not accurately represent the conditions that they experience in nature.

Crab population levels are affected by a variety of environmental and human factors, including but not limited to: upwelling patterns, onshore currents, wind, and commercial fishing. Any one of these conditions can have a devastating affect on population numbers in any year. Changes in oceanographic conditions during the larval stage can dramatically reduce survival and numbers of adults. While some mortality to crabs could occur during an individual disposal event, only a small percentage of the population present and habitat available at the MCR would be affected by an individual disposal or repetitive disposal events. These mortalities and changes in habitat would be significantly less than the changes occurring naturally at MCR.

b. Offshore Mining Operations. There are known metallic mineral deposits within the area consisting of black sands. While commercial extraction has been proposed and attempted in the past there are no known current proposals to mine offshore. There have been no exploratory wells drilled offshore near the mouth of the Columbia River. In any case, it is